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EXPÉDITION 7e CONTINENT

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NASA

2014 INTERNATIONAL WORKSHOP ON ENVIRONMENT AND ALTERNATIVE ENERGY

Plastic pollution in the oceans studied on the basis of satellite data

Raising environmental awareness thanks to the link between the oceans and space

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Mercator Ocean
Ocean Forecasters

AIRBUS DEFENCE & SPACE

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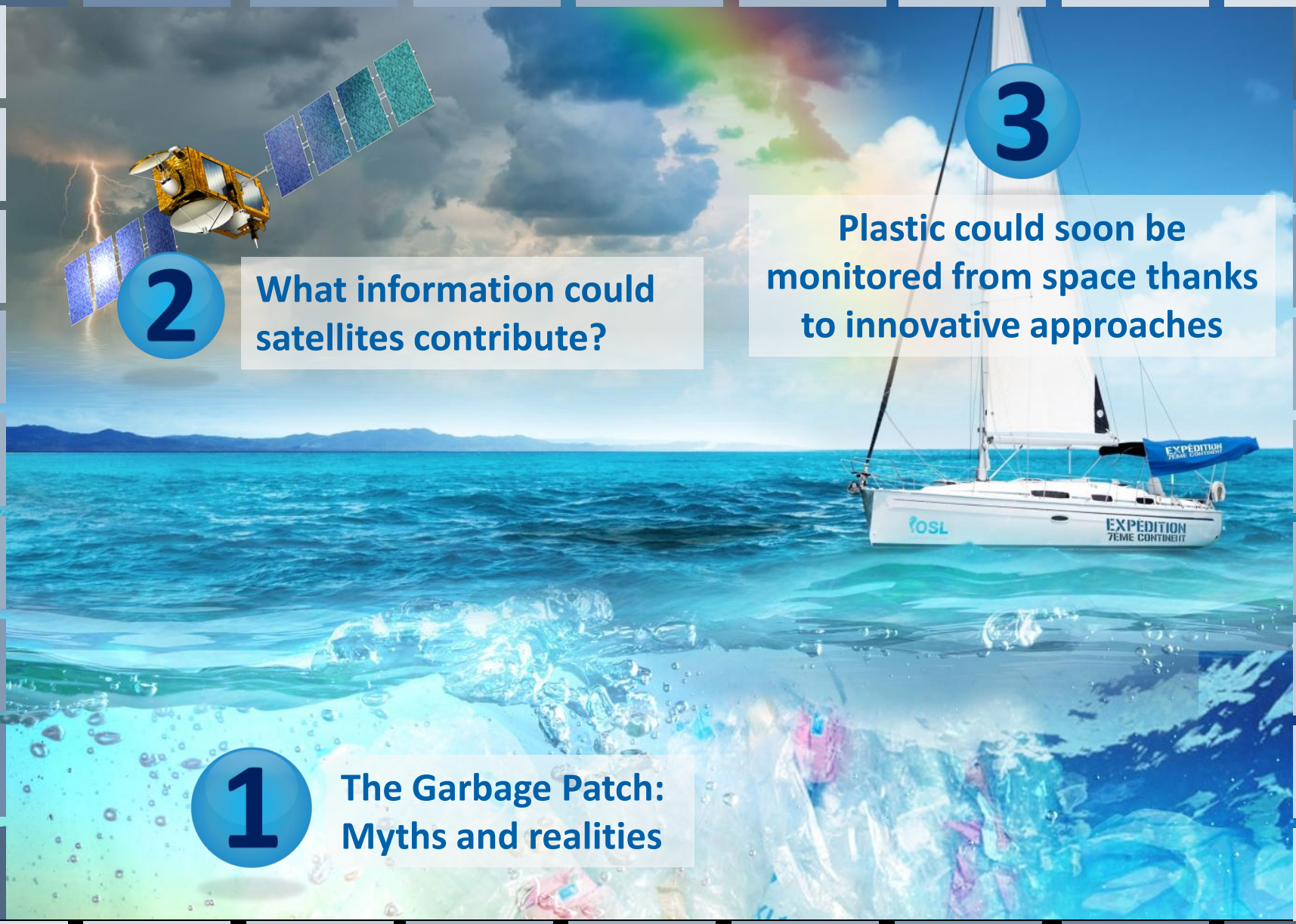
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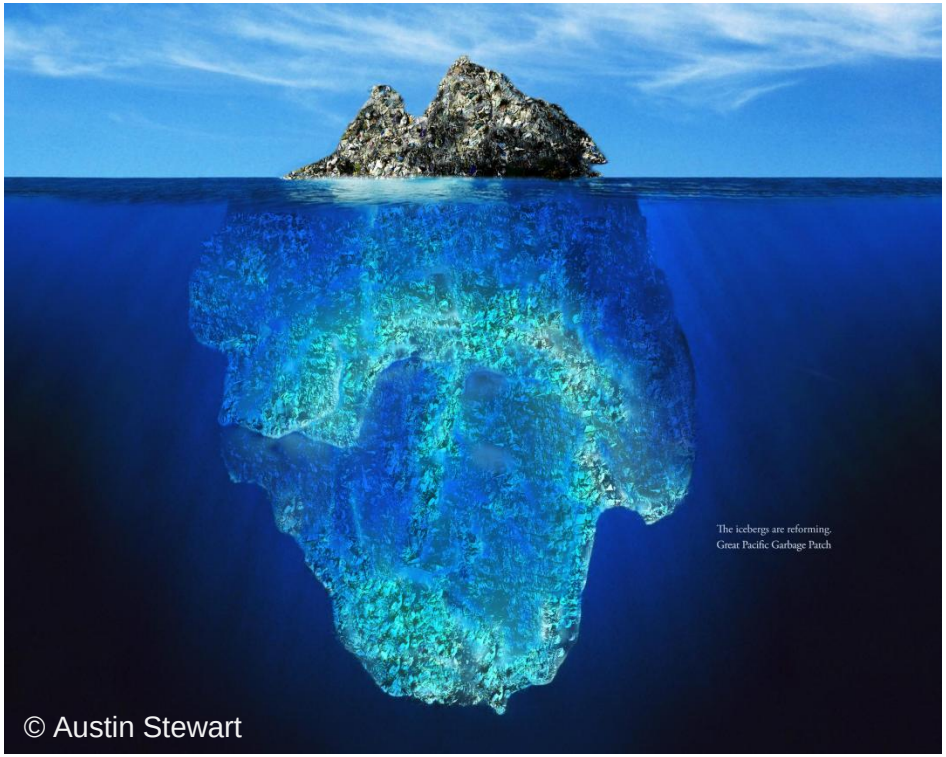
The garbage patch: myths and realities

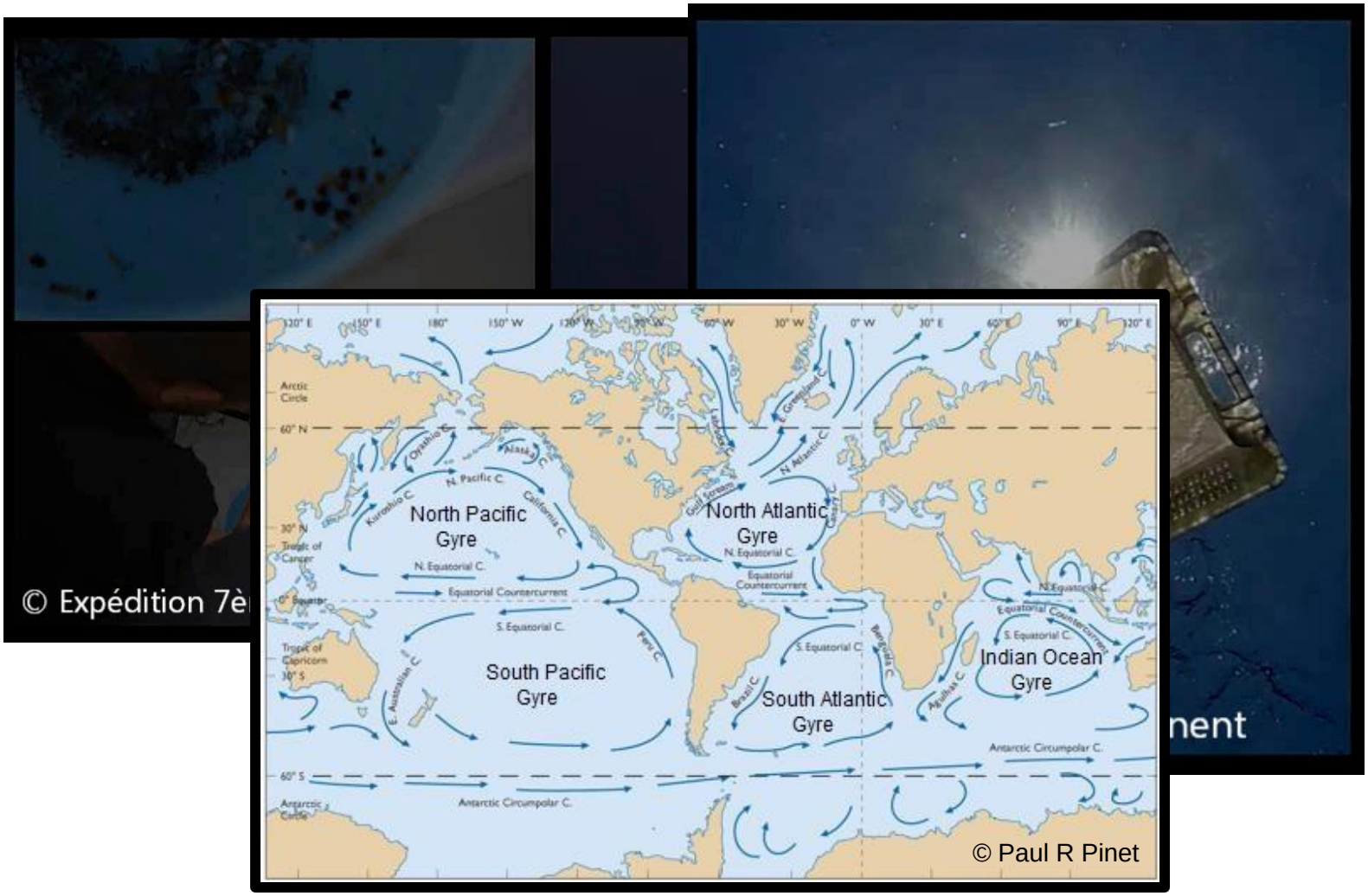
What is the truth about plastic pollution in the world's oceans?

Myth – The garbage patch

- **There is a floating island of garbage in the middle of the Pacific Ocean**



Reality – The garbage patch

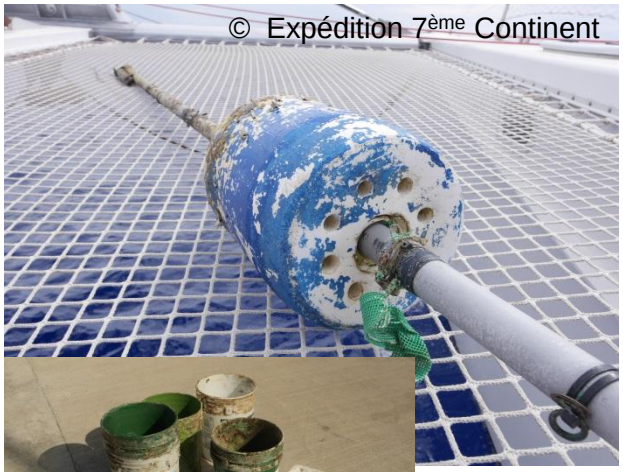


Myth – The origin of plastic

- **Water-based activities are the major causes of marine pollution**

Reality – The origin of plastic

Intact objects =
Resistant to oceanic conditions



plastic from water-based activities

Degraded objects =
Non resistant to oceanic conditions

plastic from land-based sources

Myth - Impacts

- **Plastic is just an aesthetic problem**

Reality - Impacts

Threatens marine wildlife

Allows toxins to enter the food chain

Provides long term habitat for organisms

Persists for hundreds of years

↓

great potential to alter the environment and impact humans & wildlife

What information could satellites contribute?

Global and local studies :

complementary approaches

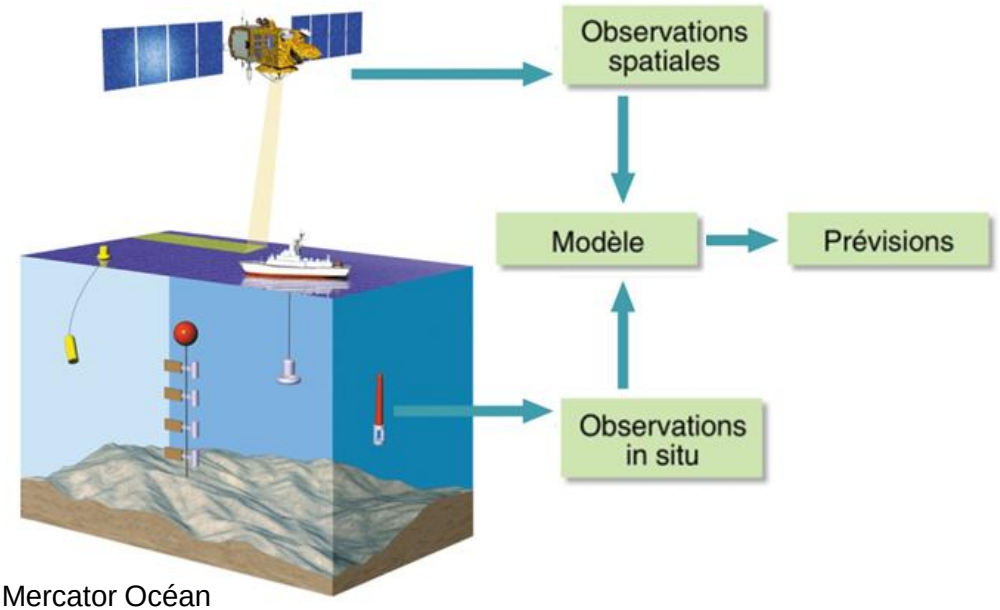
Local studies / Global studies

- **The contribution of the expeditions**
  - Information about the nature and impacts of plastic
  - Poignant evidence of this remote pollution
  - BUT localized and infrequent studies

- **The need for global knowledge**
  - Information about the gyres' size, their locations
  - AND continuous studies

- **Models using satellite data and spatial imagery could respond to this need**

Models using satellite data



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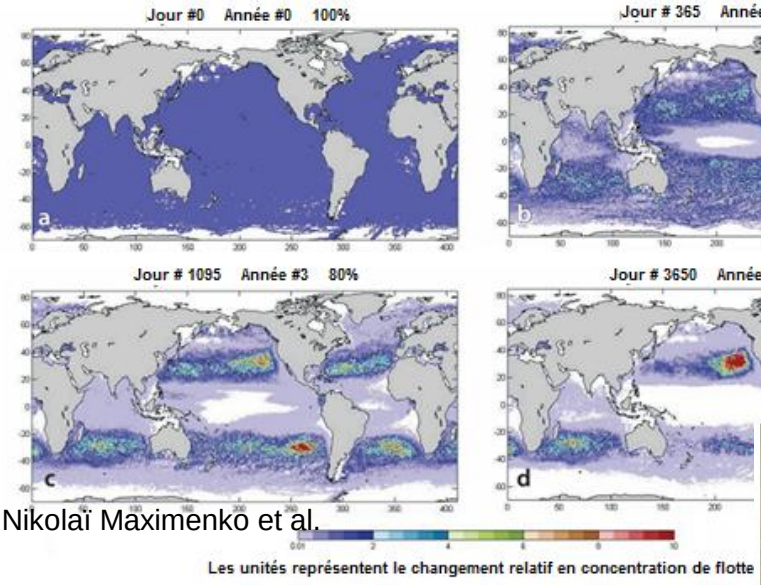
- **Why use models?**
  - Predict where the accumulation zones in the oceans are located
  - Guide the expeditions with greater accuracy

Models using satellite data

- **What models exist?**



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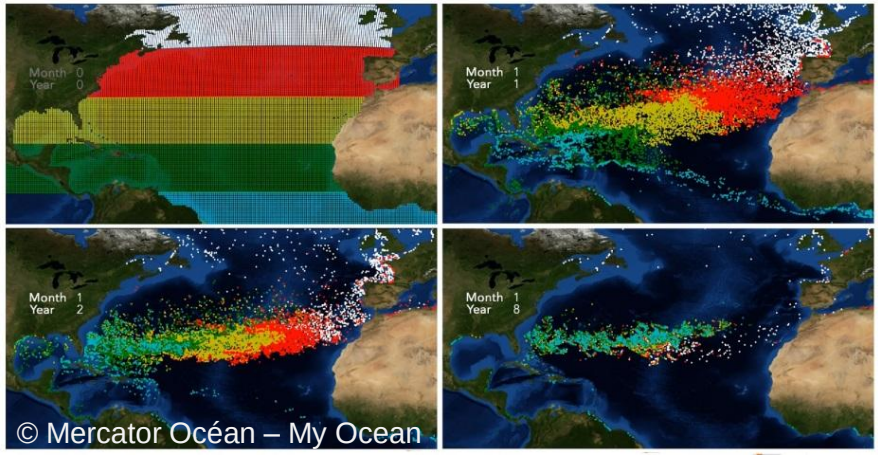
Nikolaï Maximenko's 2008

"Plastic Pollution Growth Model"

Mercator Océan's 2014

"Particle drift model"



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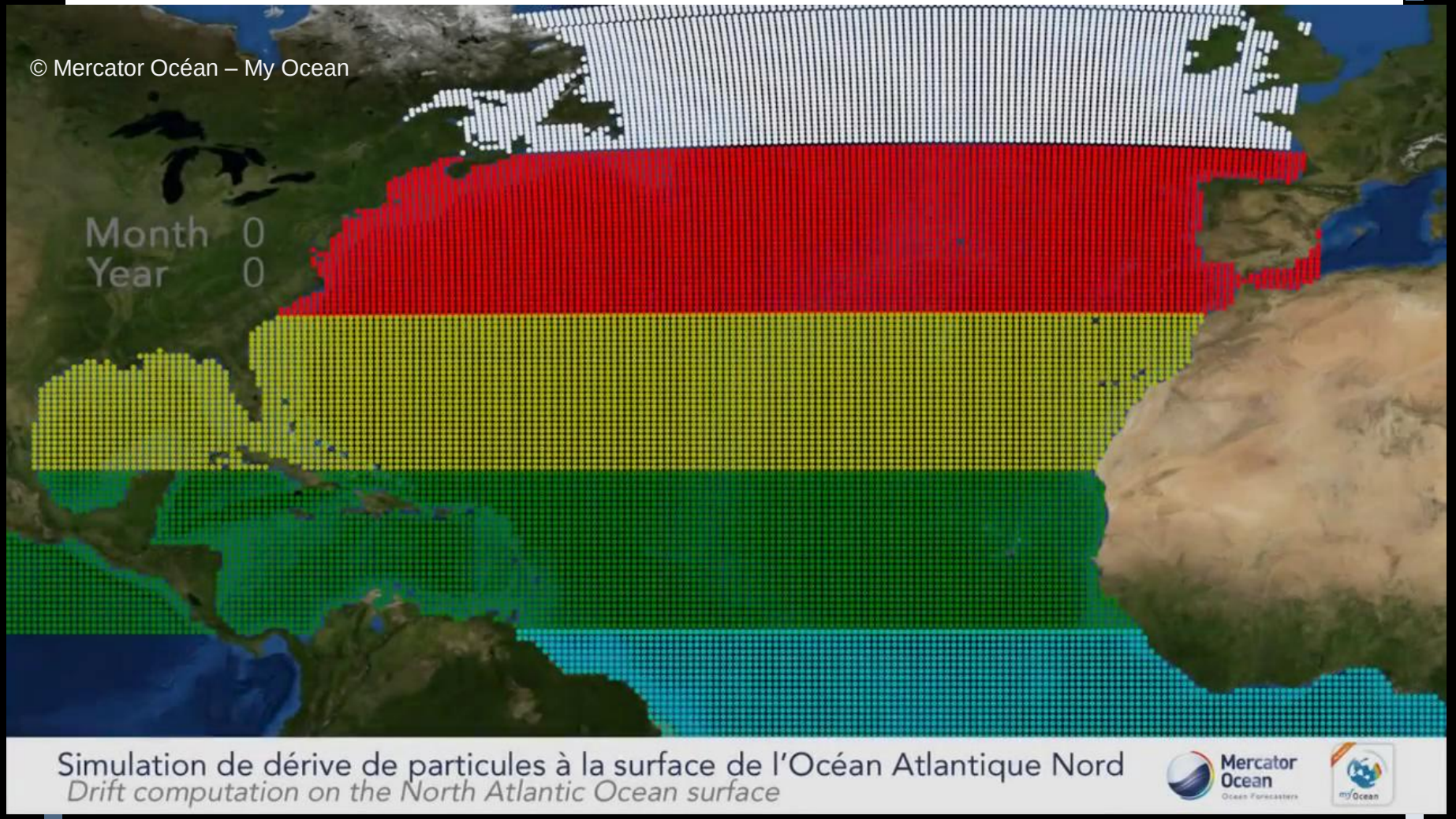
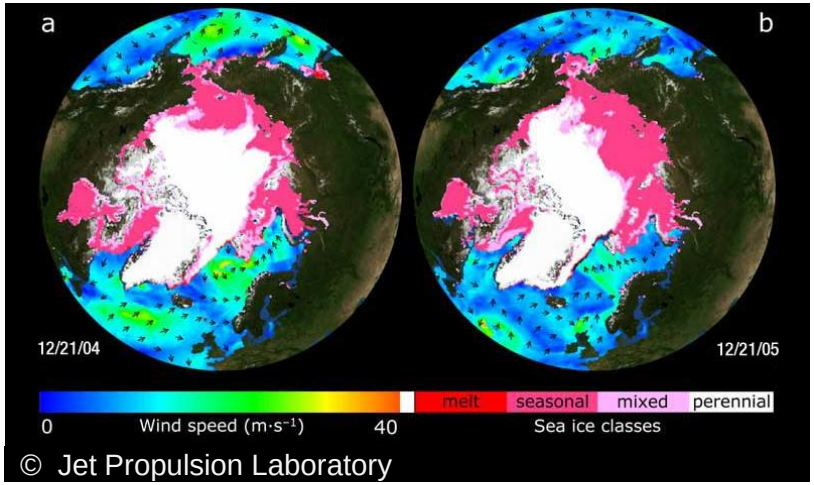
North Atlantic Ocean drift



Satellite observations

- **The complementarity of models and space-based observation**
  - Models globally predict the gyres' locations
  - BUT models ≠ reality

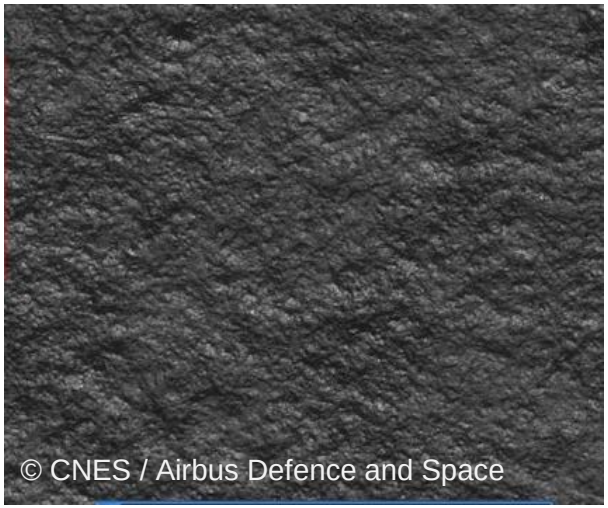
- **Being able to visualize the polluted zones would enable us to :**
  - Monitor changes
  - Show the extent of this pollution



Space imagery

- **State of the art :**
  - Until today, no one has managed to locate the plastic accumulation zones from space

- **Problems to be overcome :**
  - Deceitful pollution which cannot be easily seen
    - millimeter-length nature
    - sub-surface flotation
    - relatively low concentration

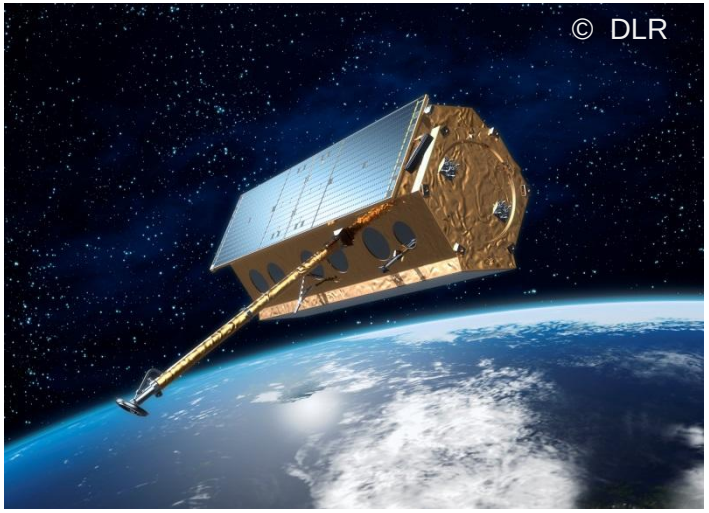


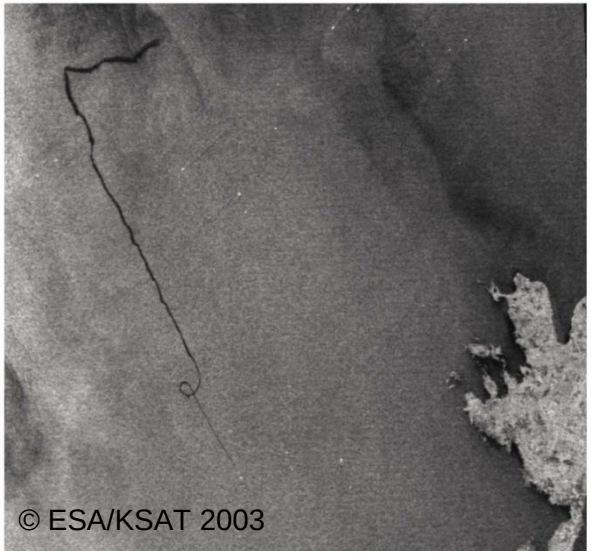
Satellites of interest

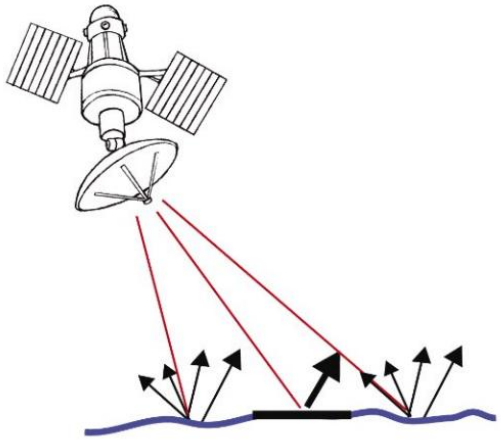
- **Very High Resolution Optical Imagers (eg : Pleiades)**
  - Often used in precise cartography
  - Goal : detect macro plastic waste

Satellites of interest

- **RADAR Systems (eg : TerraSAR-X)**
  - Often used for oil slick detection
  - Goal : detect a possible impact of plastic particles on sea surface structure







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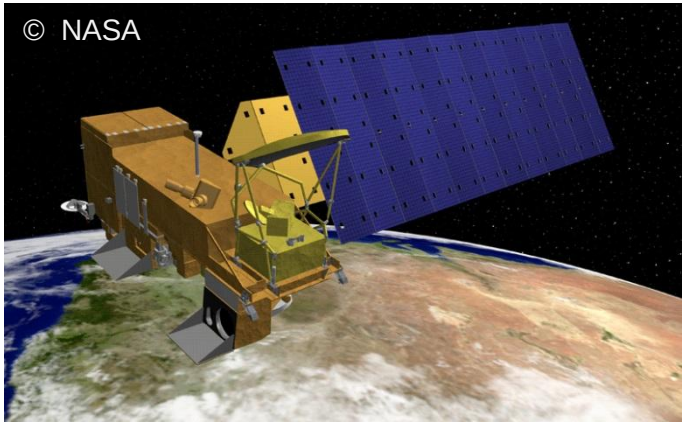
Satellites of interest

- **Moderate resolution imaging systems (eg: Aqua / MODIS)**
  - Some used for ocean color studies
  - Goal : detect a possible modification of ocean color due to floating micro plastic

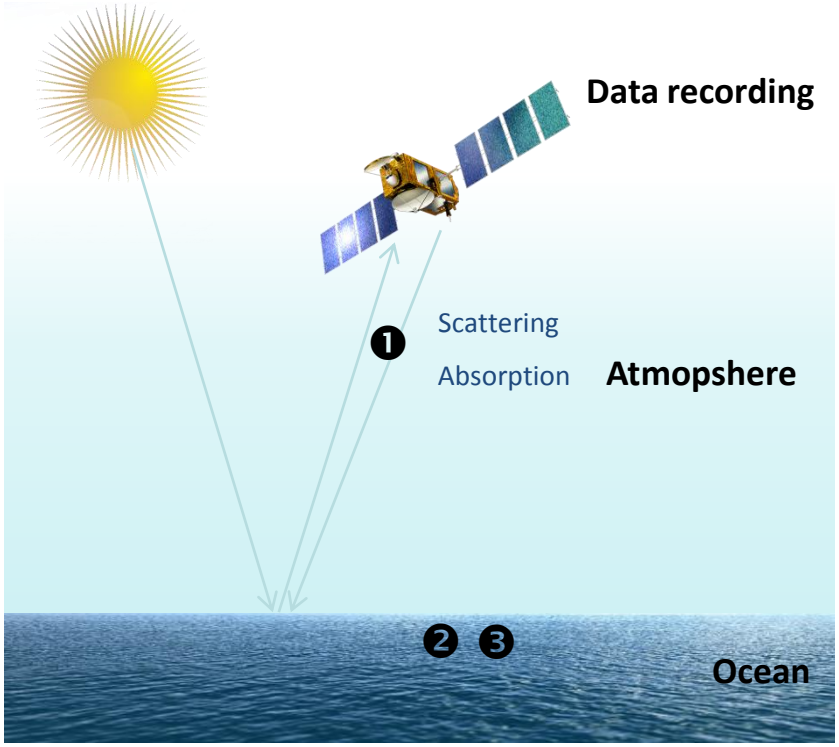


Plastic could soon be monitored from space thanks to innovative approaches

Associating satellite imaging with in-situ measures : the key to finding a particular signature associated with the plastic?

The space imagery component

- **An innovative approach**

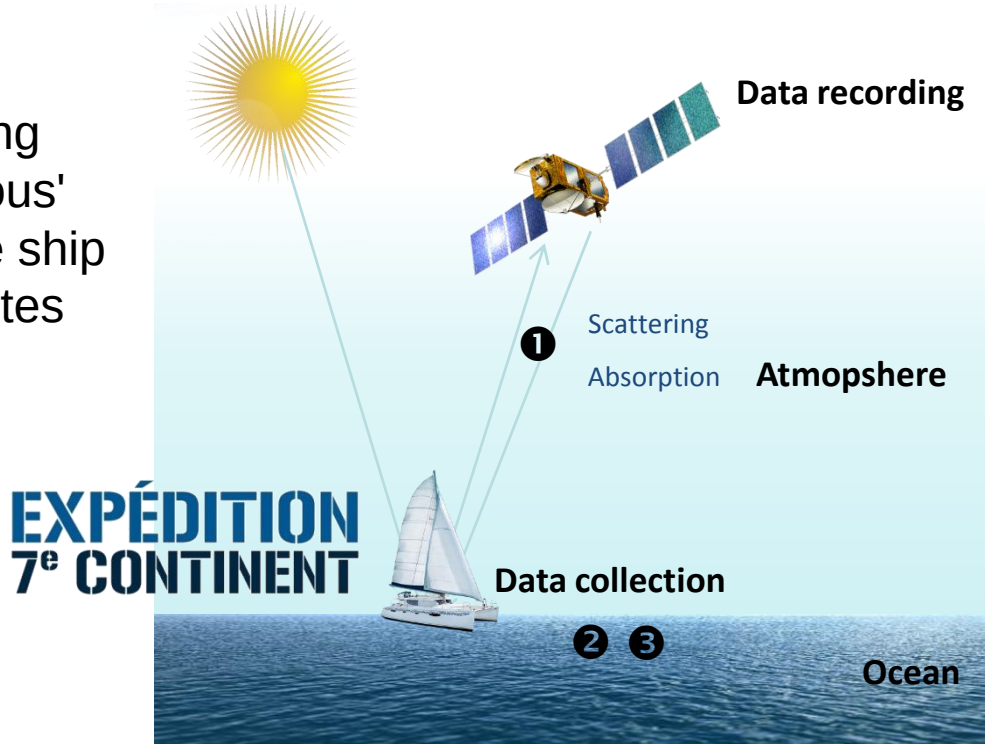


Optimizing the possibilities for satellite images analysis

The space imagery component

- **An innovative approach**

Organizing 'rendez-vous' between the ship and satellites



Acquiring in-situ and spatial collocated observations

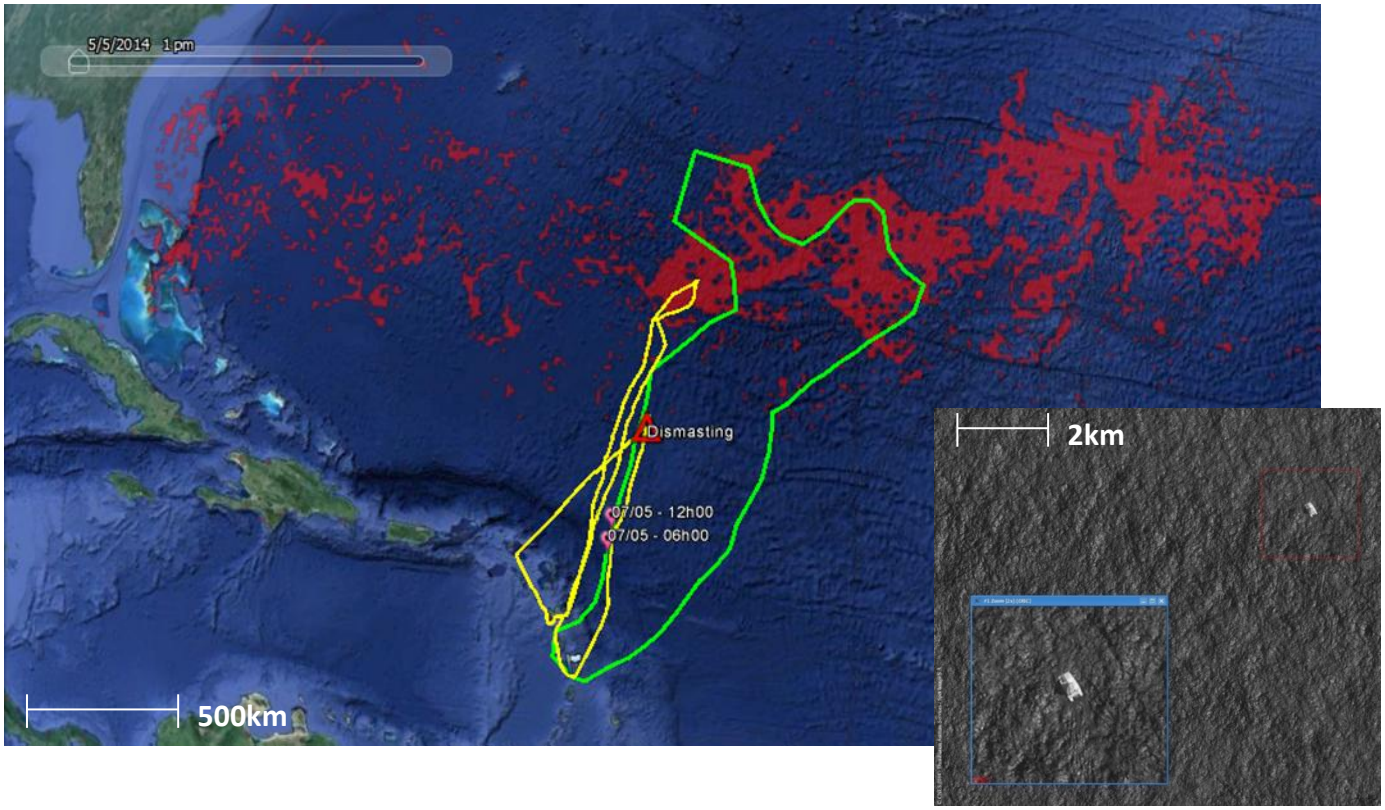
Routing the Expedition

- **Goals of the routing**
  - Direct the ship towards the gyre position shown by the drift model
  - Synchronize its path with satellites trajectories

- **Many constraints to be considered**
  - The presumed location of plastic
  - The navigation constraints
  - The needs of the other scientific components
  - Satellite trajectories

Routing the Expedition

- The projected and actual route



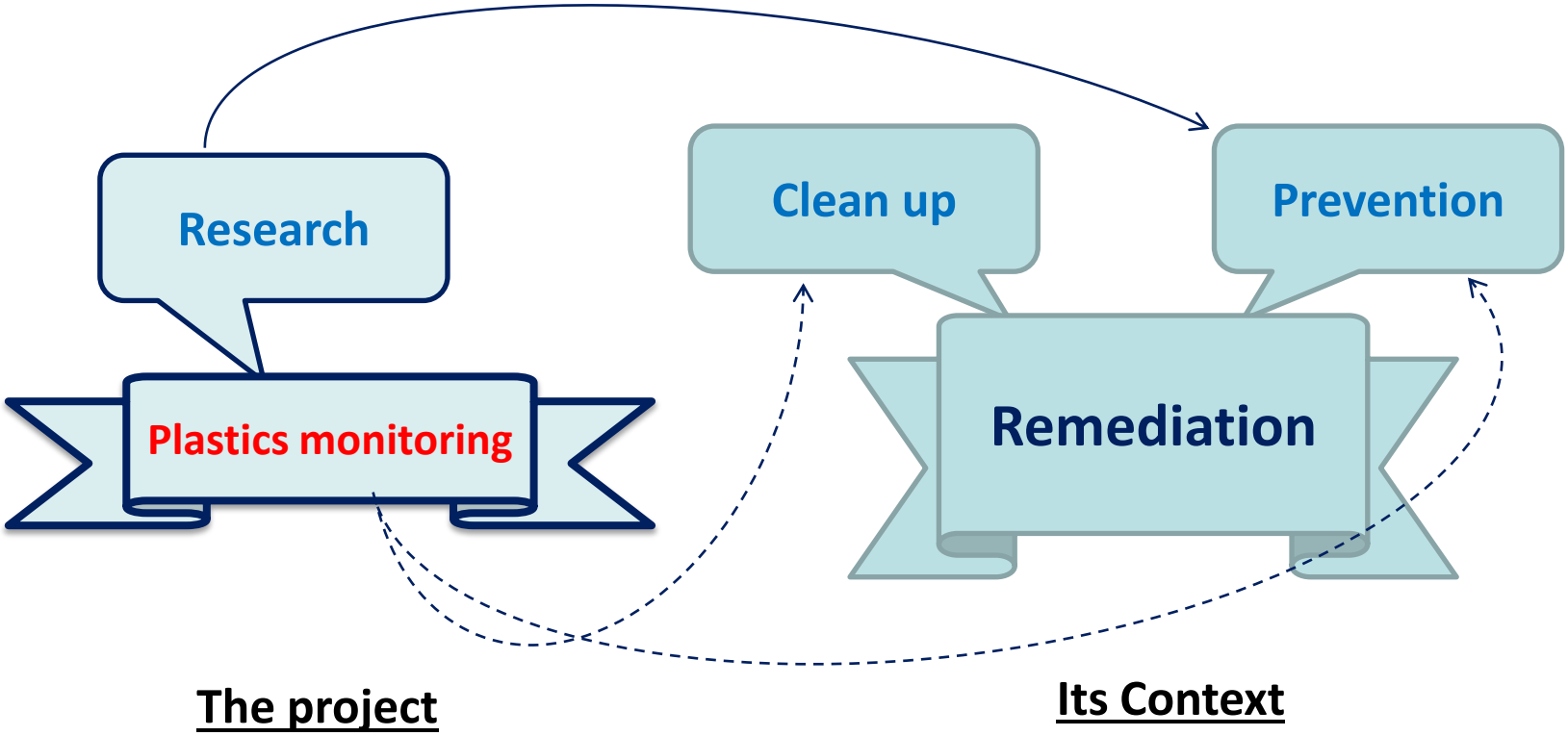
Conclusions

Conclusions

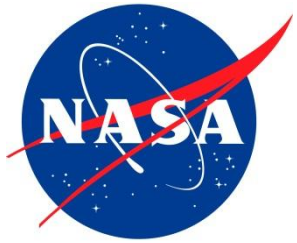
- **A « successful » search for plastic**
  - Plastic is sometimes concentrated in veins of plastic
- **Mercator Océan's model has been proven to be particularly accurate**
- **This innovative approach needs to be re-tested**
  - Crucial need for in-situ measurements

Conclusions

- Let's remember the key point



Acknowledgments



Thank you for your attention

Any questions ?